CLAIMS

We claim:

1. A method of delivering radiation treatment using multi-leaf collimation, comprising the steps of:

(a) providing a radiation fluence map which supplies a desired intensity profile;

(b) converting said fluence map into a preliminary leaf sequence, wherein said preliminary leaf sequence minimizes machine on-time and is generated without any leaf movement constraints;

(c) imposing at least one leaf movement constraint on said preliminary leaf sequence, and

(d) applying at least one constraint elimination algorithm, said algorithm adjusting said preliminary leaf sequence to minimize violations of said constraint while providing said fluence map and said minimized on-time.

2. The method of claim 1, wherein said multi-leaf collimation is segmented multi-leaf collimation.

3. The method of claim 2, wherein said constraint comprises a minimum separation distance between adjacent leaves in said leaf pair, said applying step (d) comprising:

(e) modifying at least one leaf pair in said preliminary leaf sequence to form a modified leaf sequence, wherein said modifying step comprises identifying and adjusting positions of leaves in said preliminary leaf sequence which violate said minimum separation distance to provide at least said minimum separation distance;

(f) modifying at least one leaf pair in said modified leaf sequence to produce a further modified leaf sequence, said further modified leaf sequence providing said intensity profile;

(g) examining said further modified leaf sequence for violations of said minimum separation distance, and

(h) iteratively repeating said steps (e) and (f) if at least one violation of said minimum separation distance is identified in step (g) using said further modified leaf sequence as said preliminary leaf sequence to generate a corrected leaf sequence.

4. The method of claim 3, further comprising the step of reducing a tongue-and-groove underdose, said step of reducing said tongue-and-groove underdose comprising applying a tongue-and-groove constraint to said corrected leaf sequence, said applying a tongue-and-groove constraint step comprising the steps of:

(i) modifying at least one leaf pair in said corrected leaf sequence to form a modified corrected leaf sequence, wherein said modifying step comprises identifying and adjusting positions of leaves in said preliminary leaf sequence which violate a tongue-and-groove constraint;

(j) modifying at least one leaf pair in said modified corrected leaf sequence to produce a further modified leaf sequence, said further modified leaf sequence providing said fluence map;

(k) examining said further modified corrected leaf sequence for violations of tongue-and-groove constraint, and

(l) iteratively repeating said steps (i) and (j) if at least one violation of said tongue and groove constraint is identified in step (k) using said further modified leaf sequence as said preliminary leaf sequence.

5. The method of claim 1, wherein said multi-leaf collimation is dynamic multi-leaf collimation.

6. The method of claim 5, wherein said constraint comprises a leaf interdigitation constraint, said applying step (d) comprises:

(e) modifying at least one leaf pair in said preliminary leaf sequence to form a modified leaf sequence, wherein said modifying step comprises identifying and adjusting positions of leaves in said preliminary leaf sequence which violate said interdigitation constraint;

(f) modifying at least one leaf pair in said modified leaf sequence to produce a further modified leaf sequence, said further modified leaf sequence providing said fluence map;

(g) examining said further modified leaf sequence for violations of said interdigitation constraint, and

(h) iteratively repeating said steps (e) and (f) if at least one violation of said interdigitation constraint is identified in step (g) using said further modified leaf sequence as said preliminary leaf sequence.

7. A method of reducing tongue-and-groove underdose during radiation treatment using multi-leaf collimation, comprising the steps of:

(a) providing a radiation fluence map which supplies a desired intensity profile;

(b) converting said fluence map into a preliminary leaf sequence, wherein said preliminary leaf sequence minimizes a minimum on-time and is generated without any leaf movement constraints;

(c) modifying at least one leaf pair in said preliminary leaf sequence to form a modified leaf sequence, wherein said modifying step comprises identifying and adjusting positions of leaves in said preliminary leaf sequence which violate a tongue-and-groove constraint;

(d) modifying at least one leaf pair in said modified leaf sequence to produce a further modified leaf sequence, said further modified leaf sequence providing said intensity profile;

(e) examining said further modified leaf sequence for violations of said tongue-and-groove constraint, and

(f) iteratively repeating said steps (c) and (d) if at least one violation of said tongue-and-groove constraint is identified in step (e) using said further modified leaf sequence as said preliminary leaf sequence.

8. A system for delivering radiation treatment using multi-leaf collimation, comprising:

a radiation source for generating a radiation beam;

a multi-leaf collimator having a plurality of leafs for shaping said radiation beam;

structure for generating a preliminary leaf sequence from a fluence map, wherein said preliminary leaf sequence minimizes machine on-time and is generated without any leaf movement constraints;

structure for imposing at least one leaf movement constraint on said preliminary leaf sequence, and

structure for applying at least one constraint elimination algorithm, said algorithm adjusting said preliminary leaf sequence to minimize violations of said constraint while providing said fluence map and said minimized on-time.

9. The system of claim 8, wherein said multi-leaf collimator is a segmented multi-leaf collimator.

10. The system of claim 8, wherein said multi-leaf collimator is a dynamic multi-leaf collimator.

11. The system of claim 8, further comprising structure for reducing a tongue-and-groove underdose.

12. The system of claim 8, wherein said constraint comprises a minimum separation distance between paired ones of said leaves, said structure for applying comprises:

structure for modifying at least one leaf pair in said preliminary leaf sequence to form a modified leaf sequence, wherein said structure for modifying comprises structure for identifying and adjusting positions of leaves in said preliminary leaf sequence which violate said minimum separation distance to provide at least said minimum separation distance;

structure for modifying at least one leaf pair in said modified leaf sequence to produce a further modified leaf sequence, said further modified leaf sequence providing said intensity profile;

structure for examining said further modified leaf sequence for violations of said minimum separation distance, and

structure for iteratively adjusting said leaf sequence if at least one violation of said minimum separation distance is identified.